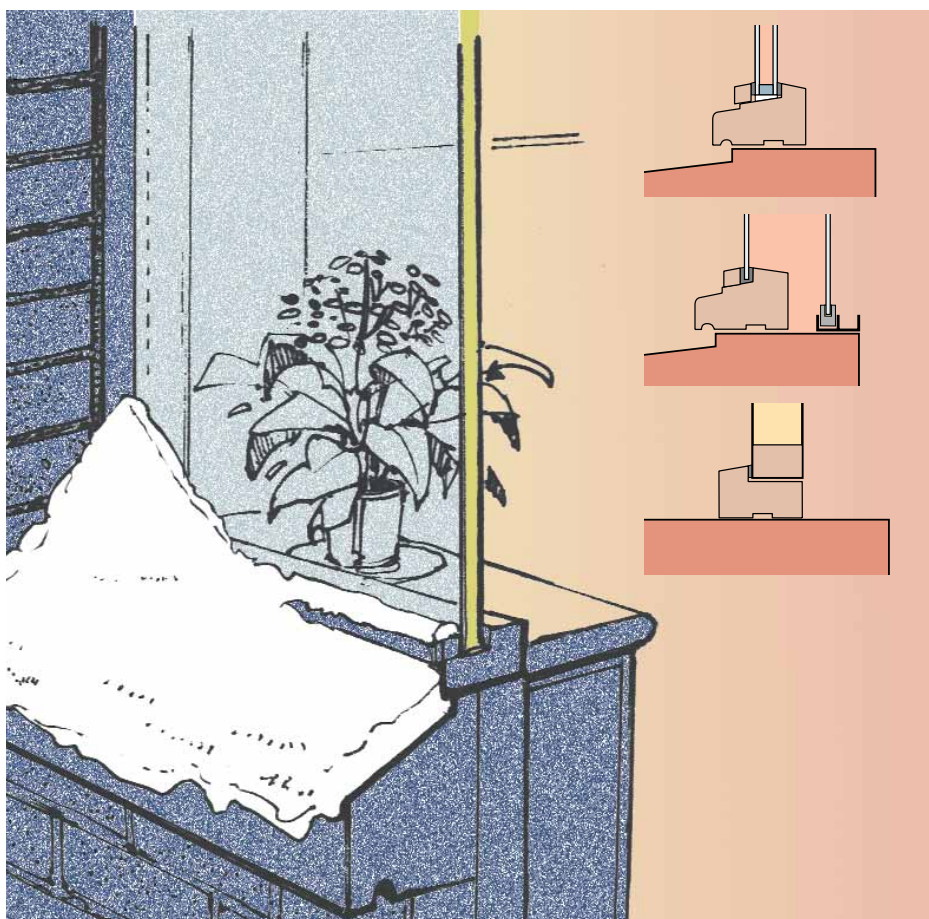


Refurbishment site guidance for solid-walled houses – windows and doors



- What energy savings to aim for
- Key points to consider
- Energy savings and SAP ratings
- Environmental considerations



**HOUSING
ENERGY EFFICIENCY**

**BEST PRACTICE
PROGRAMME**

INTRODUCTION

THE STATIONERY OFFICE

The Stationery Office, London
Tel: 0870 600 5522,
web: www.tso.co.uk

Regulations (National Details)

These documents can be obtained from The Stationery Office, London
www.tso.co.uk/bookshop.

- The Building Regulations 2000 (England and Wales) Part L1 are set out in *The Building Regulations 2000, Approved Document L1 Conservation of Fuel and Power*
- The relevant Building Standards for Scotland are set out in *The Building Standards (Scotland) Regulations 1990, 6th amendment, Technical standards to Part J, Conservation of Fuel and Power*
- The relevant Building Standards for Northern Ireland are set out in *Building Regulations (Northern Ireland) Part F Conservation of Fuel and Power*

This is one in a series of Guides aimed at architects, builders, local authorities and housing associations. It provides advice on how to improve the insulation value of windows and external doors, in order to achieve a good level of energy efficiency.

Other relevant Guides are:

- GPG 294 Refurbishment site guidance for solid-walled houses – ground floors
- GPG 296 Refurbishment site guidance for solid-walled houses – roofs
- GPG 297 Refurbishment site guidance for solid-walled houses – walls
- GPG 155 Energy efficient refurbishment of existing housing

The Guide lists the technical points to be aware of and the most suitable materials.

REGULATIONS

Building regulations vary between the nations. Building control at the local authority should be consulted for individual national standards (see left). Where applicable all aspects of national building regulations should be met.

TERMS USED IN THIS GUIDE

U-value. The measurement used to express the rate of heat loss through a wall, roof, window, etc. A roof with a U-value of 1 W/m²K would lose 1 Watt of energy through a 1 m² area of roof for every 1°C difference in temperature between the inside and outside. The lower the U-value, the better insulated the construction.

Low-e glass. This is glass with a microscopically thin coating applied to one side. The coating reflects long-wave radiation (heat that is radiated from internal room surfaces) and so reduces heat loss. The coating is barely noticeable and appears transparent.

Trickle vents. These are narrow ventilators fitted to the head of the window frame to provide a controlled 'trickle' of fresh air when the windows are closed.

Check with local authority building control and building conservation departments before replacing windows in historically sensitive buildings.

SAP RATINGS

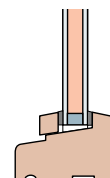
The Standard Assessment Procedure (SAP) is an energy rating which estimates the space and water heating costs (based on the size of the property and its heating and hot water system) and converts them into a rating on a scale from 1 to 120. The higher the number, the lower the energy consumption.

The SAP rating can be used to compare the relative benefits of different energy efficiency measures.

'The Government's Standard Assessment Procedure for the energy rating of dwellings. 2001 edition' is available from www.bre.co.uk/sap2001 or telephone 01923 664258.

SAP rating		Typical annual heating and hot water costs
43	typical mid-terrace house basic gas central heating	£500
46	windows double glazed and draughtstripped	£470
85	fully insulated and double glazed	£210
102	fully insulated, double glazed and with gas condensing boiler	£160

REPLACEMENT DOUBLE-GLAZED WINDOWS



Replacement windows present the ideal opportunity to upgrade the existing glazing.

WHAT TO AIM FOR

For best practice aim for U-value of 2.0* W/m²K or better. It is the **size** of the air space between the layers of glass that largely determines the insulation value of the window, **not** the thickness of glass. To achieve a value of 2.0 W/m²K or better requires the use of low-e glass.

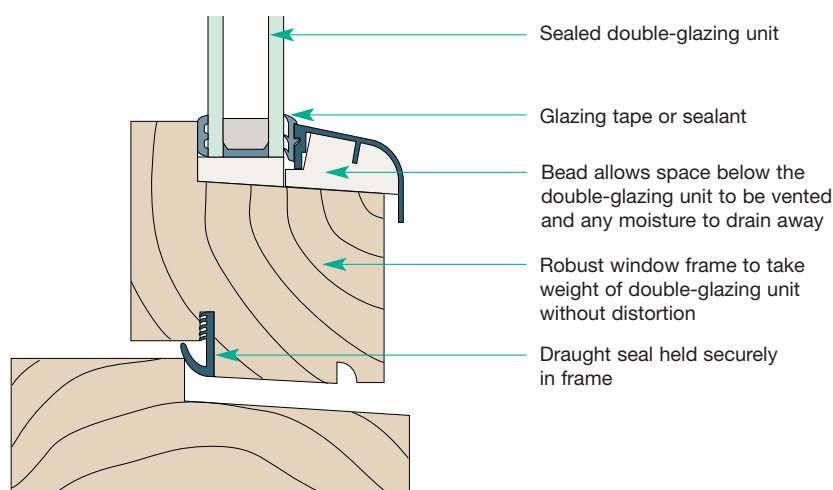
KEY POINTS

- Select a design of window frame that can accept at least a 24 mm sealed double-glazed unit – 24 mm (4:16:4) units have a 16 mm air space between the panes.
- Ideally the double-glazed unit should be glazed into the frame at the factory – site conditions can introduce problems that may shorten the life of the sealed unit. The 'drained and vented' method is the preferred method of glazing in the double-glazed units (see diagram).
- Fill the gaps between the window frame and the surrounding wall with expanding foam. This improves the window's thermal performance and reduces potential draughts.
- Where low-e glass is used, check that it is installed the right way round (usually indicated by a label).

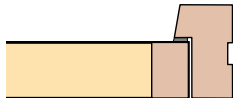
1234

InsideLow-eOutside
- Safety glazing should be used if glass in windows is within 800 mm of the floor, or glass in doors and side panels is within 1500 mm of the floor. Check with the window manufacturer what type of safety glazing to use.
- Replacement windows should incorporate 'trickle vents' in the top of the frame and draught seals.

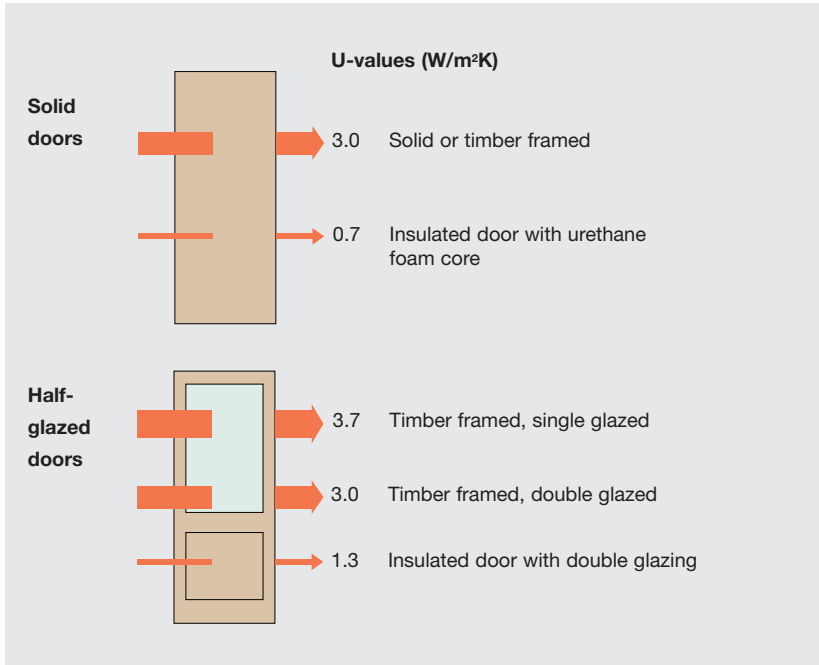
	U-values (W/m ² K)
Single glazing	4.7 Timber and PVC-U window frames 5.3 Thermally broken aluminium frames 5.8 Steel or aluminium frames
Double glazing (12 mm air filled cavity)	2.8 Timber and PVC-U window frames 3.4 Metal frames
Double glazing with soft coated low-e glass (12 mm air filled cavity)	2.1 Timber and PVC-U window frames 2.6 Metal frames
Double glazing with hard coated low-e glass (16 mm air filled cavity)	2.0 Timber and PVC-U window frames 2.5 Metal frames
Triple glazing with hard low-e coating (16 mm air filled cavity)	1.6 Timber and PVC-U window frames 2.0 Metal frames

***REQUIREMENTS FOR SCOTLAND**

The recommended window U-value of 2.0 W/m²K is suitable for some situations but in other situations a U-value of 1.8 W/m²K may be required. The local authority building control department should be consulted if there is any doubt.



REPLACEMENT EXTERNAL DOOR



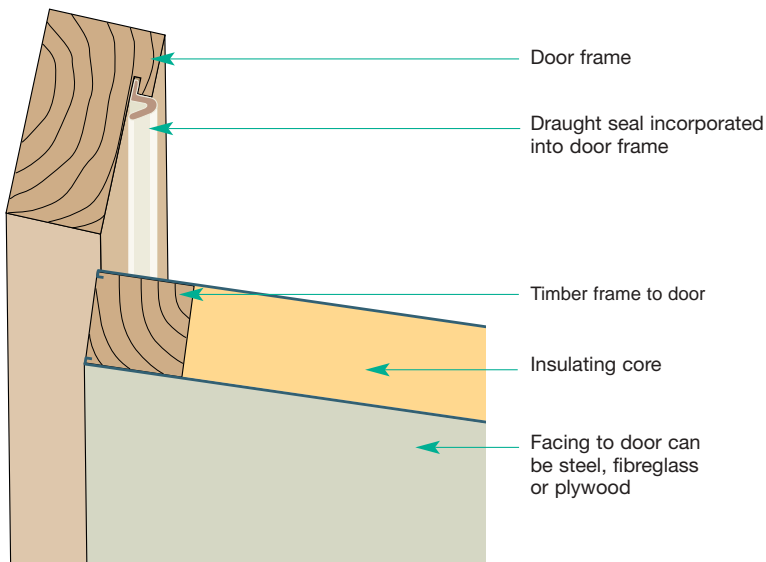
Attractive, highly insulated doors are available complete with frame, threshold and draught seals.

WHAT TO AIM FOR

For best practice aim for U-value of 1 W/m²K or less for a solid insulated door, and 1.5 W/m²K or less for a half-glazed insulated door. It is the insulating core that provides most of the insulation value – the choice of facing material makes very little difference.

KEY POINTS

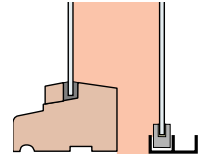
- The laminated construction of insulated doors makes them much less prone to warping than traditional timber doors.
- Insulated doors are available on their own, or can be supplied with a frame which contains an integral draught seal.
- The integral draught seals of insulated door sets achieve high levels of weather resistance.
- Any glazed area that presents a security risk should be constructed of laminated glass.
- Ensure that the door construction can incorporate the security measures you want, eg multi-point locking.



MATERIALS

- Most insulated doors have either a steel, fibreglass or timber veneered outer face. Steel-faced doors are normally supplied primed, ready for painting, while fibreglass facings can be painted or stained to imitate hardwood. Veneered doors are often factory finished.
- Nearly all insulated doors have a urethane foam insulating core contained within a timber frame that is used to provide solid fixings for hinges, locks, etc.

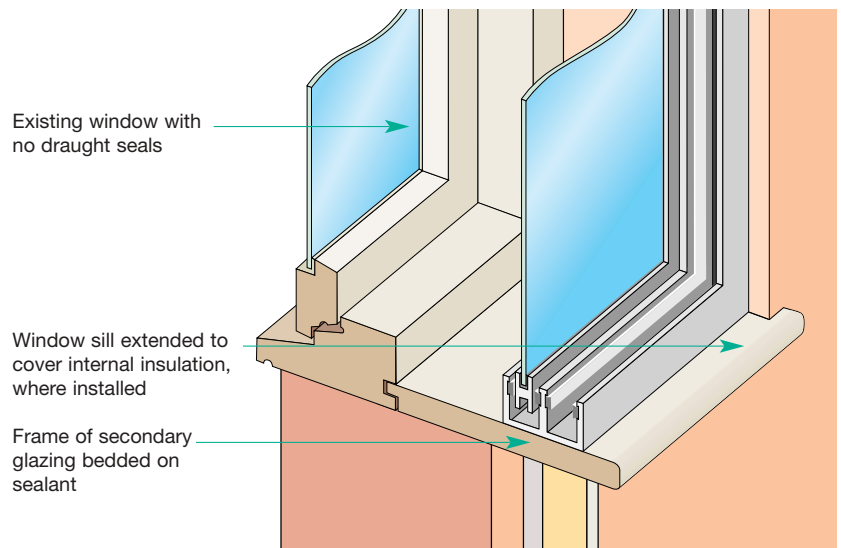
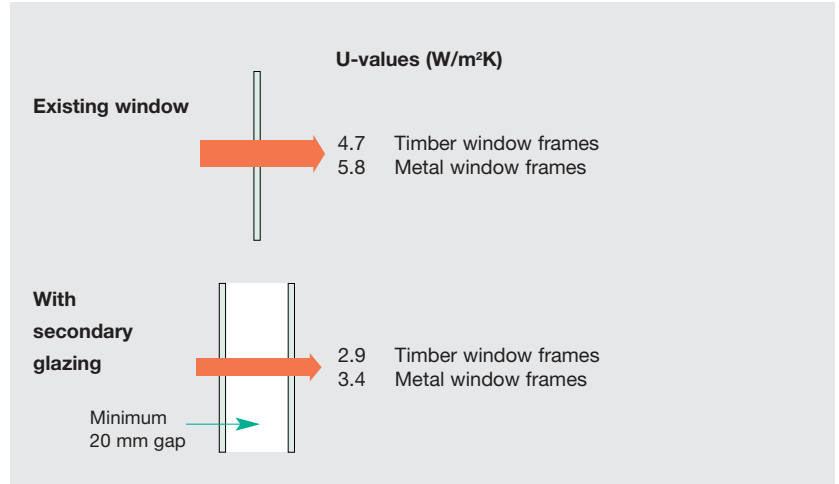
SECONDARY GLAZING



Secondary glazing can improve the insulation without replacing the existing window.

KEY POINTS

- Secondary glazing systems should be draughtstripped, but the existing windows should be left without draught seals. This allows moisture in the cavity to be vented away to the outside air.
- To improve sound insulation of the window, place the secondary glazing system at least 100 mm back from the existing glazing and line the reveals with fibreboard. This helps to absorb sound between the two panes of glass.
- Select a glazing system that can be easily opened to allow ventilation. It should be possible to leave the secondary glazing slightly open to allow a trickle of ventilation to the room.
- Do not seal windows so they cannot be opened – windows are a valuable escape route in case of fire. It is recommended that you should be able to escape through one window in each room.

**MATERIALS**

- There are many types of secondary glazing, from DIY plastic frames to expensive professionally installed sliding systems. The cheapest systems, from DIY stores, usually use acrylic sheets for glazing in place of glass and have plastic framing.
- The glazing systems supplied by specialist double-glazing installers are usually more robust than DIY systems. The specialist installer will provide a full service, including measuring up the windows before manufacture and installation.

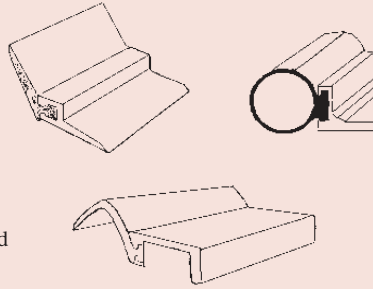
TYPES OF DRAUGHTSTRIP

DRAUGHTSTRIPS FOR DOORS

Note that these strips are intended to be typical of those currently available. Other types may be equally suitable and in all cases compliance with BS 7386 (see back page for details), is strongly recommended.

Typical strips for external door sides and tops

Seals in good quality rubber (EPDM, silicone), sheathed foam or nylon brush, with rigid PVC-U or aluminium carriers nailed or screwed to frame of door. Fitting with initial 3 mm compression allows for seasonal movement of door.



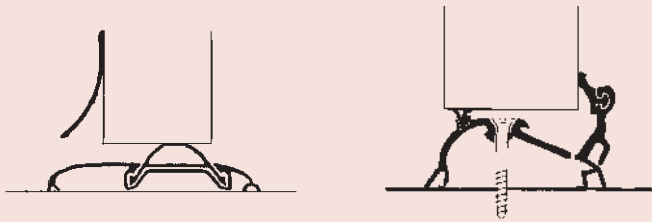
Care may be needed when painting to avoid damage to brush and some types of rubber.

Door bottom and threshold seals

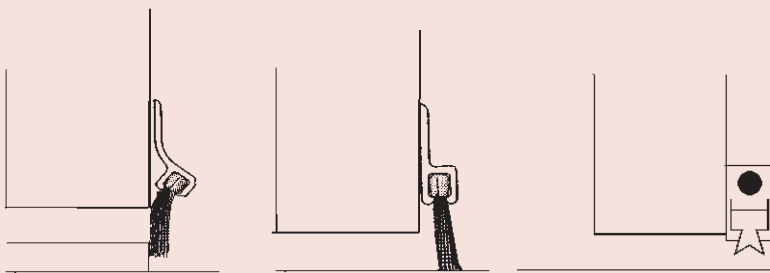
External doors

Threshold seals are normally made from aluminium and incorporate flexible draught and weather strips. Low profile sections are available for wheeled traffic and ease of access.

There are sections to cope with different exposures to driving rain.

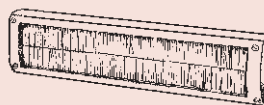


Internal and external doors



Door bottom seals consist of a rigid carrier and flexible strips, available in a variety of angles, sizes and finishes. Some types can be hidden in a groove cut into the bottom of the door. Seals which retract automatically when the door is opened are particularly useful where the floor is sloping. They can be fitted into a groove or fixed on the face of the door.

Letter box seals can be fitted to reduce draughts. Specialist products are available for fitting to keyholes.



TYPES OF DRAUGHTSTRIP

Strips for sealing the gaps around windows and the sides and tops of doors can be divided into those fitted into the gap and those fitted outside the gap. Strips which are fitted into the gap between the frame and the opening part of the window or door are used on most new windows and doors. The design and fitting of a new window or door includes making allowance for the size of the strip, which is normally fixed into a groove in the rebate.

Fitting strips into the gaps in existing windows and doors is more of a problem because of the varying gap size around the perimeter of the frame.

A careful choice of strip using the manufacturer's recommended gap size is essential as some strips are intended for use only on a limited gap range of 3-5 mm. Some low profile strips can compress to a lower gap size of 1-2 mm, making them suitable for the majority of windows.

Very small gaps over the length of a door or window can sometimes be tackled by creating a larger gap to take the strip or by using a strip fitted outside the gap (face fixed). A number of specialist companies deal with the windows in historic buildings by cutting grooves into the frame to take draughtstrips which are essentially the same as those used in new windows. Similarly, hidden brushes or seals which retract automatically when the door is opened can be fitted into the bottom sections of wooden doors.

Draughtstrips fitted outside the gap (face fixed seals) usually have two parts; a seal which moves against the door or window to close the gap, and a carrier (often made of rigid plastic or aluminium) which holds the seal firmly in place and is itself fitted to the frame. Carrier-based draughtstrips can easily cope with varying gaps around warped doors or small gaps, simply by adjusting the position of the carrier during the fitting. As the draughtstrip is exposed rather than hidden, a careful choice may need to be made to achieve an acceptable appearance.

The examples given on this page and on page 7 show some of the types of draughtstripping available. New products are constantly emerging but try to ensure that they comply with BS 7386: 1997.

DRAUGHTSTRIPS FOR WOOD WINDOWS AND INTERIOR DOORS

RESEARCH ON DRAUGHTSTRIPS AND BS 7386

BS 7386: 1997 is a performance standard for draughtstrips which are to be fitted to existing doors and windows. Draughtstrips which comply with the standard are likely to operate successfully for many years and to recover their initial cost in fuel savings.

Durability in BS 7386 is assessed using a 20 000 cycle 'wear' test with a simulated door or window section. It is also essential that the draughtstrip recovers its shape after being compressed and that the elastic properties of the rubber or other draughtstrip material are maintained. This is tested by measuring the 'recovery' of the draughtstrip at low and high temperatures (to simulate ageing) as well as at room temperatures. There is also a 'peel' test for products which are glued into position, and a 'pullout' test for those which have a carrier.

FITTING OF DRAUGHTSTRIPS

For exterior doors, draughtstrips with a range of 6 mm, with a compression allowance of 3 mm, are recommended. This will accommodate seasonal variation in gap size up to 3 mm. If the gap expands, the seal is maintained; if it shrinks, closing the door is not affected. For windows, both the seasonal movement and the opening length are likely to be less than for doors, and an initial compression of 3 mm is recommended.

General guidance on fitting draughtstrips and ventilation is covered in BS 7880: 1997 and accompanies BS 7386, see back page for details. Guidance is currently available from manufacturers and the Draught Proofing Advisory Association.

DRAUGHTSTRIPS FOR WOOD WINDOWS AND INTERIOR DOORS

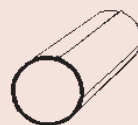
Typical strips fitted to the frames of wood windows and interior doors

Rubber tube fixed to carrier.

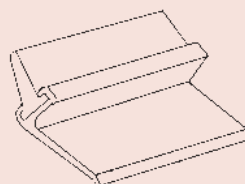


Good for interior doors and wood casement windows. Not suitable for sliding doors or windows.

Silicone 'O' tube (variety of sizes) glued with silicone adhesive. Several sizes available to cover gaps up to 10 mm.

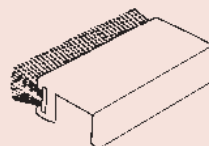


Angled blade seal.



Good for wooden doors and casement windows. Some types suitable for sliding applications.

Brush pile (various heights) bonded to carrier.

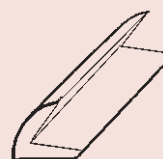


Suitable for most doors and window types. Especially good on sliding windows and doors but care needed when repainting to avoid damaging pile.

Brush pile, self-adhesive, available in several pile heights for different gaps.

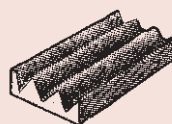


V-shaped seal in silicone, EPDM or sheathed foam. Glued (or stapled to wooden frames).



Covers gaps up to about 7 mm and some recent types down to less than 1.5 mm in one size. Can be used where other types are unsuitable.

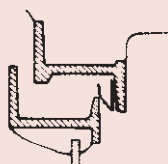
Expanded rubber, self-adhesive fixed.



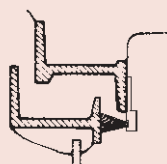
Only suitable for small range of gap sizes and not capable of being compressed down to fit small gaps; hence limited usefulness.

Steel windows often have very small gaps, especially on the hinge side, and specialist draughtstrips may be needed. These include:

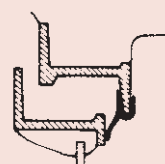
Tube and V-seals as used on wooden windows above



Face-fixed seals which are glued or screwed to the steel frame



'Clip on' seals where a carrier is simply fitted into position over the thin steel section of the frame.



Silicone or polyurethane mastic can be used as a gap filler. This does not allow for any seasonal movement, but may be the only solution if the gaps are very small.

ENVIRONMENTAL CONSIDERATIONS AND FURTHER INFORMATION

ENVIRONMENTAL CONSIDERATIONS

There is growing global pressure to ensure that construction materials are sustainable. Whilst energy efficiency initiatives over the last 30 years have reduced the energy needed to heat a typical house considerably, initiatives to reduce the impact from construction materials have been comparatively slow.

The Green Guide to Housing Specification (Anderson and Howard, BRE, 2000) provides a useful reference for construction products, giving A,B,C environmental ratings for over 250 specifications. This definitive guide, developed over 20 years and supported in its current form by the National House-Building Council (NHBC), is predominantly based on life cycle assessment data from the DETR-supported BRE Environmental Profiles scheme. The Guide contains an extensive list of references to all of its sources of data.

Despite their comparatively low mass, windows and doors typically contribute between 5 and 10% of the embodied environmental impact of a house.

As rated by the Green Guide to Housing Specification, PVC-U has a poor environmental

rating due to the high energy intensity of the materials' manufacture and the fact that it has no recycled input; however the industry is taking steps to encourage the recycling of PVC-U.

Primary aluminium manufacture is also very energy intensive though much less energy is needed to process recycled aluminium. But although aluminium extrusions contain around 30% recycled aluminium, and are also extensively recycled, the high impacts from primary and secondary aluminium manufacture still result in high overall environmental impact for aluminium windows.

Softwood timber windows, made from renewable material requiring low energy in manufacture, perform well. As with all timber products, specifiers should ensure that the timber is sustainably grown. This is particularly relevant for tropical hardwood windows, which also involve much longer transport distances. Locally grown hardwoods will have similar impacts to softwood. Information on sustainably sourced timber is available from the Forest Stewardship Council (see right for contact details).

HOUSING ENERGY EFFICIENCY BEST PRACTICE PROGRAMME DOCUMENTS

The following publications are available from the HEEBPp Helpline, telephone 01923 664258.

Good Practice Guides (GPG)

- GPG 155: Energy efficient refurbishment of existing housing
- GPG 294: Refurbishment site guidance for solid-walled houses – ground floors
- GPG 296: Refurbishment site guidance for solid-walled houses – roofs
- GPG 297: Refurbishment site guidance for solid-walled houses – walls

More detailed assessment of window materials is given in the BRE Report listed below.
BR 390: The Green Guide to Housing Specification

British Standards Institute (BSI)

- BS 7386: 1997. Specification for draughtstrips for the draught control of existing doors and windows in housing (including test methods).
- BS 7880: 1997. Code of practice for draught control of existing doors and windows in housing using draughtstrips.

British Woodworking Federation

Guide to specifying wood windows

Contact Information

British Coatings Federation

Tel 01372 360660
www.coatings.co.uk

British Plastics Federation

Tel 020 7457 5037
www.bpf.co.uk

British Standards Institution

Tel 020 8996 9000
www.bsi.global.com

British Wood Preserving and Damp-proofing Association

Tel 01332 225 100
www.bwpda.co.uk

British Woodworking

Federation Tel 020 7608 5050
www.bwf.org.uk

BRE

Tel 01923 664000
www.bre.co.uk

Draught Proofing Advisory Association

Tel 01428 654011

Forest Stewardship Council

Tel 01686 413916
www.fsc-uk.demon.co.uk

Glass and Glazing Federation

Tel 020 7403 7177
www.ggf.org.uk

Steel Window Association

Tel 020 7637 3571
www.steel-window-association.co.uk

Energy Efficiency Best Practice in Housing

Tel: 0845 120 7799
www.est.org.uk/bestpractice

Energy Efficiency Best Practice in Housing is managed by the Energy Saving Trust on behalf of the Government. The technical information was produced by BRE.

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